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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: S. ISHIHARA, et al.

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Title: ORGANIC LIGHT EMITTING ELEMENT AND DISPLAY DEVICE USING ORGANIC LIGHT EMITTING ELEMENT

Group: 2875

Examiner: Sumati KRISHNAN

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REQUEST FOR RECONSIDERATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

November 7, 2003

Sir:

In response to the Office Action dated May 8, 2003, the period of response for which extension is requested by the attached Petition for Extension of Time, reconsideration and allowance of this application is respectfully requested for the reasons set forth below.

Before discussing the merits of the application and the distinctions of the originally submitted claims over the cited prior art, a brief review of features of the invention will be discussed (noting that this discussion is solely for purposes of providing a brief summary, and not intended to limit the invention only to the features discussed in this summary).

The present invention is directed to organic light emitting elements and organic light emitting displays using such elements. As discussed beginning on page 2, line 14 et seq., prior art organic light emitting liquid crystal display

devices have suffered from a problem of low extracted light efficiency. In particular, as noted on page 2, lines 18-20, typically only about 20% of the light produced in such an organic liquid crystal display device is actually extracted. An important factor regarding this low extracted light efficiency is the critical angle which exists between the incident light and the normal of the substrate. In conventional devices, light generated in the organic liquid crystal display device which is beyond the critical angle will be totally reflected rather than passing through to the outside. The present invention is directed to reducing the amount of reflection thereby to increase the light extraction efficiency.

In accordance with one aspect of the invention, discussed, for example, beginning on page 5, a distance d from the light emitting area of an organic light emitting layer to the air layer to which the light enters can be set to $d \leq \lambda/4$ (λ : center wavelength of emitted light). This is discussed, for example, on page 20 of the application with regard to the distance between the light emitting area of the organic light emitting layer 105 and the outer surface of the passivation layer 108. By virtue of setting the distance in this manner, as discussed on page 21, line 16 et seq:

"in the element of this embodiment, the total reflection did not occur for the outgoing light with an incident angle greater than the critical angle. Thus, the total amount of light from the organic light-emitting element of this embodiment increased by 1.5 that of the comparison example."

As such, Applicants discovery of this critical distance setting serves to bring the refractive index of the device to close to 1 so that the extracted light

efficiency will not be significantly degraded by total reflection beyond the critical angle (e.g. see page 5, lines 7-27).

A second aspect of the present invention can be appreciated from Figure 2 and the discussions found beginning on page 6 and on page 21. Referring to Figure 2, it can be seen that a counter electrode 203 is provided with a light extraction layer 201 interposed between the counter electrode 203 and the organic electroluminescent substrate 204. This arrangement with the light extraction layer also serves to permit the light produced inside the device to be projected into the surrounding air layer with a refractive index close to 1, thereby avoiding degradation of the light extraction efficiency due to total reflection (e.g. see page 5, lines 13-19). As discussed on page 6, lines 11 et seq., the counter substrate serves to prevent the undesired entry of water and air from the atmosphere into the organic electroluminescent element 204 as well as operating in conjunction with the light extraction layer 201 to improve the light extraction efficiency.

Reconsideration and allowance of independent claim 1 and its dependent claims 20 and 21 over the combination of Fukuda (United States Patent No. 6,541,130) and Tang (United States Patent No. 5,684,365) is respectfully requested. Claim 1 defines the above noted first feature of the invention shown, for example, in Figure 1 in which a distance being between the light emitting area of an organic layer (such as 105 in Fig. 1A) to an air layer (such as 111 in Fig. 1) into which the produced light enters satisfies the equation $d \leq \lambda/4$ (λ : center wavelength of emitted light). As noted above, this setting of the distance within the organic light emitting device services to reduce the total reflection in a boundary area between the organic light

emitting element (layers 101-108) and the air layer 111, thereby significantly increasing the light extraction efficiency. In addition to the portions discussed above, these features are also discussed on page 15, line 13 through page 16, line 1 as well as from page 33, line 18 through page 34, line 13.

The primary reference to Fukuda, on the other hand, completely fails to teach or suggest the setting of the claimed dimension. On the contrary, Fukuda is directed to providing an optical distance from a light emitting interface to an interface bordering on a metal electrode that is substantially equal to odd multiples of one quarter of the wave length. In other words, Fukuda is concerned with the metal electrode and the light emitting interface, but does not consider the thickness of the metal electrode itself. If one considers that a light emitting element disclosed in Fukuda is added to the thickness, it is quite clear that the distance from the light emitting interface to the atmosphere (that is, the air layer outside of the device) will be much larger than that defined by claim 1.

The secondary reference to Tang teaches a passivation layer, but does not provide any teachings which would suggest the modification of Fukuda that would be necessary to arrive at the claimed invention. Indeed, if one adds the passivation layer disclosed in Tang to the Fukuda reference, this would serve to enlarge the distance from the light emitting interface to the air layer to be much larger than that defined in claim 1. Therefore, reconsideration and allowance of claim 1 and its dependent claims 20 and 21 over the combination of Fukuda and Tang is respectfully requested.

Reconsideration and allowance of independent claim 2 and its dependent claims 6, 7, 11 and 12 over Nagayama (United States Patent No.

5,742,129) is also respectfully requested. Claim 2 defines the feature discussed above with regard to Figure 2 (referred to solely as an example) of providing a light extraction layer between an organic electroluminescent substrate and a counter substrate (for example, the light extraction layer 201 between the organic electroluminescent substrate 204 and the counter substrate 203 shown in Figure 2). Again, this overall arrangement serves to substantially improve the light extraction efficiency. In addition to the portions noted above, this is further discussed on page 23, line 8 through page 23, line 9 of the specification.

Nagayama, on the other hand, fails to teach or suggest the combination of features set forth in independent claim 2 regarding the light extraction layer, the counter substrate and the electroluminescent substrate. On the contrary, Nagayama is directed to conductive films disposed on either side of the substrate, and does not teach or suggest disposing a light extraction layer between an organic light emitting substrate and a counter substrate. As such, Nagayama fails to anticipate or suggest the invention defined by independent claim 2.

Reconsideration and allowance of independent claims 3, 4 and 5 over the various cited combinations of references (in conjunction with Nagayama and Fukuda) is also respectfully requested. The rejection of each of these claims is based on either Nagayama and Fukuda, and, inasmuch as these claims define similar features to those filed in claims 1 and/or 2, these rejections fail to teach or suggest the claimed limitations for the reasons noted above. In addition, none of the cited secondary references would lead to one make the modifications would require to Nagayama and Fukuda to arrive at

the claimed inventions. In particular, no motivation is provided in any of the cited prior art to make the substantial modifications which would be necessary to arrive at the features defined in the independent claims 3, 4 and 5. Therefore, reconsideration and allowance of these claims is also respectfully requested.

Finally, reconsideration and allowance of the dependent claims in this case is also requested. These claims depend on the above discussed claims, and, as such, define further features of the invention and overall combinations which are not suggested or taught by the cited prior art, whether considered alone or in combination. Therefore, reconsideration and allowance of these various dependent claims is also earnestly solicited.

If the Examiner believes that there are any points which can be resolved by way either a personal or telephone interview, the Examiner is invited to contact Applicants undersigned attorney at the number indicated below.

To the extent necessary, Applicants petition for an extension of time under 37 CFR §1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (Case No. 500.41280X00) and please credit any excess fees to such deposit account.

Respectfully submitted,
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